DIRECT DETERMINATION OF MOMENTUM-RESOLVED ELECTRON TRANSFER IN PHOTOEXCITED MoS_2/WS_2 VAN DER WAALS HETEROBILAYER

FANG LIU, QIUYANG LI, XIAOYANG ZHU[a], *Chemistry, Columbia University, New York, NY, USA*.

Photo-induced charge separation in transition metal dichalcogenide heterobilayers is being explored for moiré excitons, spin-valley polarization, and quantum phases of excitons/electrons. While different momentum spaces may be critically involved in charge separation dynamics, little is known directly from experiments. Here we determine momentum-resolved electron dynamics in the WS_2/MoS_2 heterobilayer using time and angle resolved photoemission spectroscopy (TR-ARPES). Upon photoexcitation in the K valleys, we detect electrons in M/2, M, and Q valleys/points on time scales as short as ∼70 fs, followed by dynamic equilibration in K and Q valleys in ∼400 fs. The interlayer charge transfer is accompanied by momentum-specific band renormalization. These findings reveal the essential role of phonon scattering, the coexistence of direct and indirect interlayer excitons, and constraints on spin-valley polarization.

[a]To whom correspondence should be addressed. E-mail: xyzhu@columbia.edu